

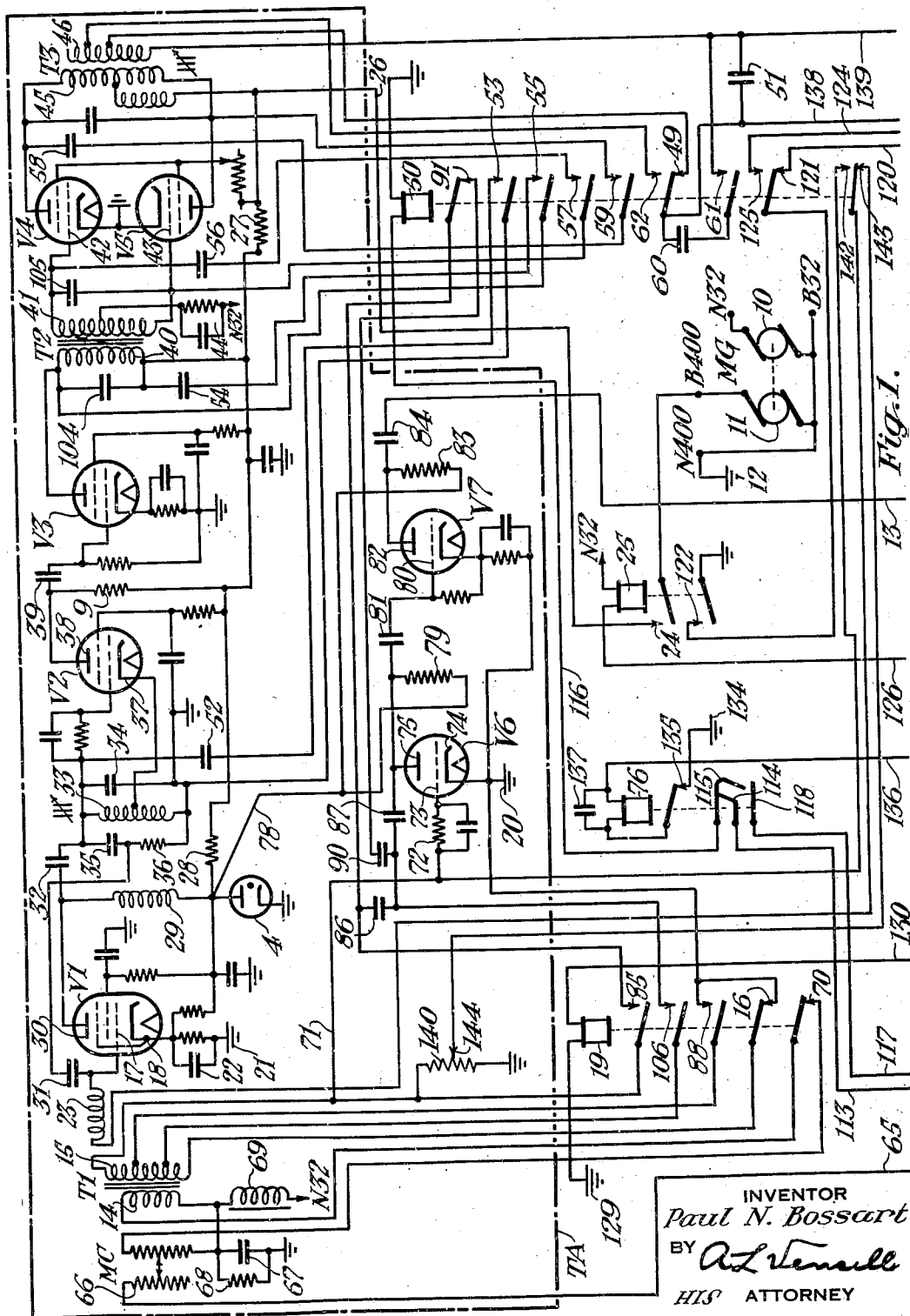
Oct. 11, 1949.

P. N. BOSSART
RAILWAY TRAIN COMMUNICATION AND ALARM SYSTEM
USING MODULATED CARRIER CURRENTS

2,484,680

Filed Jan. 30, 1945

3 Sheets-Sheet 1



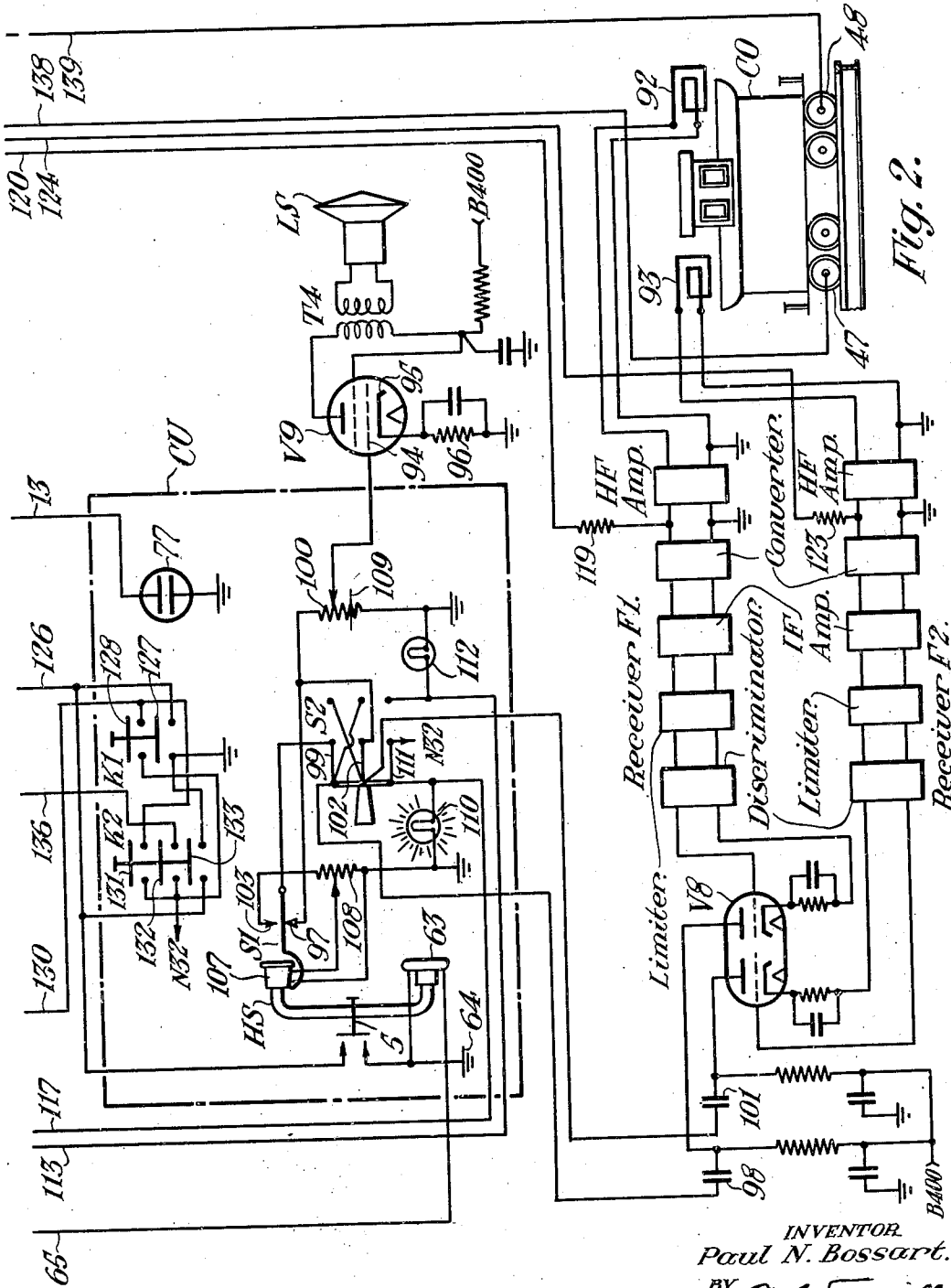
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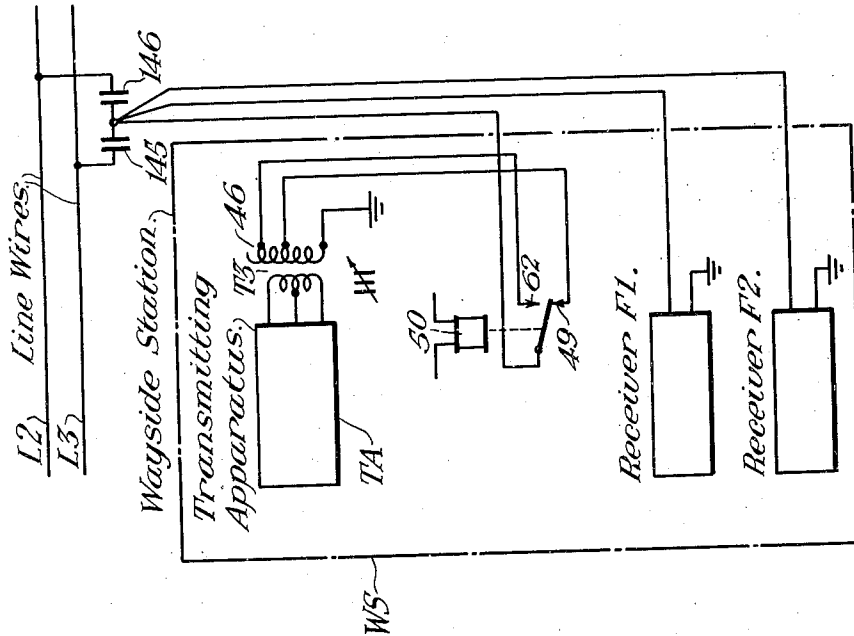


Fig. 4.

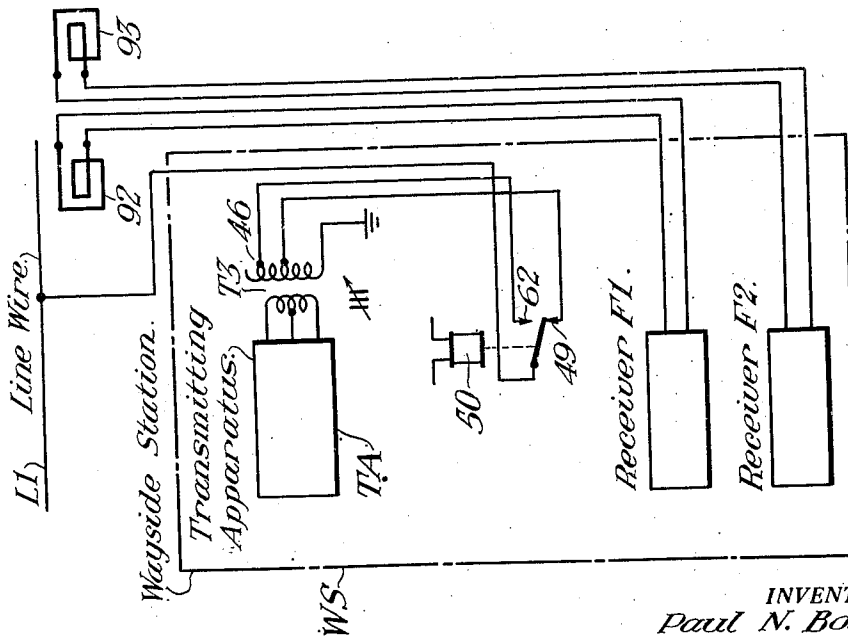


Fig. 3.

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UNITED STATES PATENT OFFICE

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RAILWAY TRAIN COMMUNICATION AND
ALARM SYSTEM USING MODULATED
CARRIER CURRENTS

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Application January 30, 1945, Serial No. 575,311

19 Claims. (Cl. 179—82)

1

My invention relates to railway train communication systems, and more particularly to multiple channel train communication systems.

When train communication is installed on all or nearly all of the trains of a railway division and also at one or more wayside stations, some form of selection is necessary. That is to say, if end to end communication is being carried on by the crew of one train the train crew of a second nearby train should be able to carry on communication without interference between the two trains. Also an operator at a wayside station should be able to communicate with a train without interfering with end to end communication of other trains. Furthermore, if the office operator or any other station should wish to break in on a conversation to issue train orders, such should be permitted. In other words, when an entire railway division is equipped for train communication, a plurality of different communication channels and a break in feature are essential.

Accordingly, a feature of my invention is the provision of novel and improved apparatus for a multiple frequency channel train communication system.

Another feature of my invention is the provision of railway train communication apparatus incorporating novel means for selecting a particular frequency channel of a plurality of different channels for communication.

Still another feature of my invention is the provision of railway train communication apparatus incorporating novel means for calling a train or station on each one of a plurality of different frequency channels.

Again, a feature of my invention is the provision of apparatus of the type here contemplated for calling a station that is already in communication and for cyclically calling a station on each of a plurality of different channels.

A further feature of my invention is the provision in apparatus of the type here involved of novel means to reduce the receiver sensitivity for the channel in use during a conversation so that the integrity of the transmitter and receiver may be checked by side tones from the receiver.

Another feature of my invention is the provision of train communication apparatus incorporating novel means to suppress background noises and to provide pre-emphasis.

2

Again, a feature of my invention is the provision of improved railway train communication apparatus using frequency modulation with a trackway transmitting circuit which includes the track rails and line wires and other conductors extending parallel along the railway.

Other features, objects and advantages of my invention will appear as the specification progresses.

I attain the aforementioned features, objects and advantages of my invention by the provision of transmitting apparatus capable of being conditioned to supply frequency modulated carrier telephone current of any one of a plurality of different carrier frequencies, and receiving apparatus responsive to each of said frequency modulated carrier telephone currents. That is, each such carrier serves as a frequency channel. The receiving apparatus is normally conditioned to receive a calling current on any one of the channels, but the transmitting apparatus is excited and made active only during periods current is to be sent out. Preferably the receiving apparatus includes an individual or independent receiver for each channel, the different receivers being connected in multiple to a loud speaker to sound a calling tone signal received on any one of the channels, each channel having its individual tone. Through the hook switch of a telephone hand set and other manually operable switches, the hand set when removed from the hook switch is connected to the channel of which a calling signal has been received, but the loud-speaker is left connected to the other channels to sound a calling signal if it is found necessary to break in on the conversation being carried on through the selected channel. That is, when the hand set is hung on its hook switch, a calling signal or speech on any one of the frequency channels is received in the loud-speaker, but when the hand set is off the hook the channel selected for conversation is connected to the hand set only and the other channels are connected to the loud-speaker.

In addition, each receiver includes means to check the operativeness of the transmitter and of the receiver of the channel in use. To this end the receiver of the channel in use is kept active during transmission but its sensitivity is greatly reduced because of the very strong energy it will pick up from the local transmitter. This reduc-

tion in sensitivity is made only during the talking period. Thus there is sounded in the local ear-phone at a normal energy level the conversation that is being sent out. Reduction in the sensitivity of the receiver during the transmitting period prevents overloading of the receiver and permits self-monitoring at a comparatively low energy level.

The transmitting apparatus is preferably of the reactance-variation type of frequency modulating transmitter, and its various elements are provided with different capacitors through which the transmitting apparatus can be selectively conditioned for any one of a plurality of different frequency channels.

On railway trains there exists a large amount of background noise which if transmitted may be objectionable, and to overcome this I provide an adjustable microphone circuit network whose sensitivity can be set so that the usual background noise is ineffective to operate the transmitter. This requires the speaker to speak relatively loud and close to the microphone. In connection with such sensitivity adjustment of the microphone I provide the transmitting apparatus with indication means so that the speaker can readily tell when he is talking loud enough to cause the proper frequency swing of the transmitting apparatus. Such indication means preferably includes a gas discharge type of lamp connected to the microphone circuit through an amplifier to flash the lamp when the speaker is speaking at the correct loudness.

Pre-emphasis is of a considerable help in improving the signal noise ratio in systems which operate at times near the noise level, and pre-emphasis is provided in the apparatus by a resistance-capacity circuit in the microphone network. In adjusting the microphone network, it is important that the amount of pre-emphasis does not change and a resistance pad is used to accomplish such results.

I provide a calling current by impressing an audio frequency on the modulator through contacts of a calling relay, a different pitch being used for each channel. Such calling frequency is attained through the use of an adjustable electron tube oscillator and preferably I switch an amplifier tube of the indication means to an oscillator to serve as a tone generator. Also the secondary winding of the microphone transformer is preferably switched to serve as the inductance of the oscillating circuit of the tone generator. Separate oscillator tube and inductance can be used, if desired.

I provide a special control unit together with control relays to govern the condition of the transmitting apparatus for operation at the different channel frequencies and to effect the different calling conditions. This control means also includes an emergency calling means which when set into operation functions to send calling pulses cyclically on each of the frequency channels.

At wayside stations I preferably couple the apparatus to the trackway transmitting circuit by connection to a line wire extending along the railway. Switching means is used to increase the voltage applied to the line wire at the lower carrier frequency.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Figs. 1 and 2 with Fig. 1 placed above Fig. 2 are diagrammatic

views showing one form of apparatus embodying my invention when used with a train carried station of a two frequency channel train communication system. Fig. 1 discloses the transmitting apparatus, certain control relays, and a source of power, and Fig. 2 discloses the receiving apparatus and a control unit. Figs. 3 and 4 are diagrammatic views showing wayside station line wire connections for the apparatus of Figs. 1 and 2.

In each of the several views like reference characters are used to designate similar parts.

Referring to Figs. 1 and 2, the reference character CO designates a vehicle of a railway train on which the communication apparatus is mounted. This vehicle, CO may be the caboose of a freight train for which two way communication with remote stations is provided, such remote stations being on another vehicle of the same train, on vehicles of other trains and at wayside stations. Each such remote station will of course be provided with communication apparatus similar to that disclosed in Figs. 1 and 2.

The caboose CO is provided with a source of power, such as the usual 32 volt car lighting system, the terminals of this source being designated B32 and N32. The 32 volts of this source are converted into a voltage suitable for use with electron tubes through a motor generator MG, a motor 10 of which is connected to the 32 volt source and a generator 11 of which is provided with terminals B400 and N400 from which a relatively high voltage is obtained. The positive terminal B32 and the negative terminal N400 are connected to a ground electrode 12. The caboose is also provided with a series of control relays 19, 25, 50 and 76, and a control unit indicated as a whole by a dash and dot rectangle CU, which relays and unit will be referred to from time to time as the specification progresses.

A dash and dot rectangle TA (Fig. 1) designates the transmitting apparatus. This transmitting apparatus TA comprises as essential elements a microphone circuit network including a transformer T1 and a potential divider 140, a reactance modulating tube V1, an oscillator tube V2, a driver amplifier tube V3, a power amplification stage including tubes V4 and V5, indication amplifier tubes V6 and V7, and a calling means which includes tube V6 as an oscillator and a winding of the transformer T1 as the inductance of the associated oscillating circuit.

A primary winding 14 of transformer T1 is connected to the microphone circuit in a manner to appear hereinafter, and secondary winding 15 of the transformer is included in a control grid circuit for the reactance tube V1. This grid circuit extends from control grid 17 through choke coil 23 and either of two alternative paths to cathode 18 of the tube. The first path includes back contact 143 of relay 50 to be referred to later, adjustable terminal 144 of potential divider 140, wire 71, winding 15, back contact 16 of relay 19 also to be referred to later, ground electrodes 20 and 21 and biasing unit 22. The second path includes front contact 142 of relay 50, wire 71 and thence the same as the first path. The plate circuit for tube V1 is provided with power from terminal B400 of the generator 11, through front contact 24 of a directional relay 25 governed in a manner described later, wire 26, resistors 27 and 28, impedance 29, plate 30 and tube space to cathode 18, biasing unit 22 and ground electrodes 21 and 12 to terminal N400. A voltage limiter tube 4 is connected to the plate circuit to improve frequency stability.

The oscillator tube V2 has associated therewith an oscillating circuit comprising inductance 33 and capacitor 34. A phase shifting network comprising capacitor 35 and resistance 36 in series is connected across the oscillating circuit and assures the correct phasing of the reactance modulator tube V1. Cathode 37 of tube V2 is connected to an intermediate terminal of winding 33 of the oscillating circuit, and plate 38 of the tube V2 is provided with power from terminal B400 of the current source through a circuit including front contact 24 of relay 25, wire 26, and resistors 27 and 9. The parts are so proportioned that oscillations of a preselected carrier frequency which I shall call frequency f_1 are produced, an adjustment of the inductance of the coil 33 for such frequency being provided through an adjustable core structure as indicated in Fig. 1.

The control grid circuit and plate circuit of tube V1 are coupled through capacitors 31 and 32 to the oscillating circuit with the result tube V1 serves as a variable reactance for the oscillating circuit. Thus voltages applied to the control grid of tube V1 cause variations in the reactance of the tube as it appears to the oscillating circuit and in turn cause corresponding frequency variations of the oscillations created by the oscillating circuit, with the result the oscillations are frequency modulated according to the voltage applied to the grid of reactance tube V1.

The plate circuit of oscillator tube V2 is resistance coupled to a control grid circuit of amplifier tube V3 through a capacitor 39. The plate circuit of the amplifier tube V3 is powered from terminal B400 through primary winding 40 of a coupling transformer T2. Primary winding 40 and secondary winding 41 of the coupling transformer T2 are normally tuned to resonance at the frequency f_1 by capacitors 104 and 105, respectively, and by adjusting variable iron cores. Secondary winding 41 of transformer T2 has its outside terminals connected to control grids 42 and 43 of tubes V4 and V5, respectively, of the power amplification stage, and its mid terminal is connected to the negative terminal N32 of the power source through a biasing unit 44 so that each control grid 42 and 43 is provided with a preselected bias voltage. The plate circuits of tubes V4 and V5 include primary winding 45 of an output transformer T3 in a push-pull arrangement. A first preselected portion of secondary winding 46 of the output transformer T3 is connected through a back contact 49 of the relay 50 to a sending loop circuit the lead wires 138 and 139 of which loop circuit are connected to the pairs of wheels 47 and 48 of the caboose. Such sending loop circuit is tuned to resonance at the frequency f_1 through the use of a variable capacitor 51 connected across the lead wires 138 and 139.

Relay 50 serves as a frequency change-over unit for the transmitting apparatus TA, the apparatus being conditioned to supply a carrier telephone current of the channel frequency f_1 when the relay is released and the transmitting apparatus being conditioned to supply a different and a lower channel frequency which I shall call frequency f_2 when the relay is picked up. When relay 50 is released the various elements of the transmitting apparatus are tuned in the manner described hereinbefore and the apparatus is conditioned to supply the channel frequency f_1 , but when the relay 50 is picked up in a manner to appear hereinafter, an adjustable capacitor 52 is connected through front contact 53 of relay 50 to

the oscillating circuit and the oscillations are shifted to the carrier frequency f_2 . The primary winding 40 and secondary winding 41 of coupling transformer T2 are shifted in their tuning to the channel frequency f_2 by means of an adjustable capacitor 54 connected across winding 40 through front contact 55 of relay 50, and an adjustable capacitor 56 connected across winding 41 through front contact 57 of relay 50. Also, an adjustable capacitor 58 is connected across primary winding 45 of the output transformer T3 through front contact 59 of relay 50, an adjustable capacitor 60 is connected across the sending loop circuit through front contact 61 of the relay, and a second portion of the secondary winding 46 of the output transformer is connected to the sending loop through front contact 62 of the relay to condition the circuits for the channel frequency f_2 .

From the foregoing description of the transmitting apparatus TA it is apparent that when the frequency change-over relay 50 is released, transmitting apparatus TA is conditioned to operate on the first channel frequency f_1 and when relay 50 is picked up the transmitting apparatus is conditioned to operate on the second channel frequency f_2 . It is also apparent that voice frequency voltages appearing in the secondary winding 15 of microphone transformer T1 cause through the reactance tube V1 a corresponding frequency modulation of the carrier created by the oscillating circuit for tube V2, and such frequency modulated carrier current is amplified to a predetermined energy level and applied to the sending loop circuit of the caboose, such sending loop circuit including the track rails between the wheels 47 and 48 with the result that the communication current is made to flow in a trackway transmitting circuit or channel including the rails and paralleling line wires in the well-known manner.

Since a smaller per cent frequency swing is needed for the same absolute frequency swing at the higher channel frequency, and since less oscillator capacity is used, the potential divider 140 is interposed in the grid circuit of tube V1 when relay 50 is released to condition the transmitter for the higher frequency f_1 and it is by-passed when relay 50 is picked up to condition the transmitter for the lower frequency f_2 . In this manner the same voice current produces the same absolute frequency swing for both channel frequencies.

I shall now describe the microphone circuit network with the sensitivity adjustment, pre-emphasis, and modulating indication features.

A microphone 63 of a hand set HS of the control unit CU has one terminal connected to ground electrode 64 and its other terminal connected through wire 65 to a so-called L-pad 66, the pad 66 being connected to ground through an impedance unit consisting of a capacitor 67 and a resistor 68 in multiple, and being connected through a circuit connection including choke coil 69 to the terminal N32 of the current source. Consequently the microphone network is energized from the 32 volt current source, the proper value of microphone current being obtained by the correct value of the resistance of choke coil 69. Primary winding 14 of the microphone transformer T1 is connected to a terminal of the pad 66 through a back contact 70 of the relay 19 and to one terminal of coil 69. This L-pad 66 is so constructed that it presents a substantially constant resistance to the audio frequency current flowing in the microphone circuit network. The

impedances of the pad 66 and capacitor 67 of the impedance unit are chosen to be of substantially the same order at the higher voice frequency of say 2400 cycles per second. Then for a lower voice frequency, the impedance of capacitor 67 becomes relatively greater than the resistance component of the impedance of the microphone circuit and the currents flowing are proportionately reduced at the lower voice frequency. Thus at 600 cycles, the impedance of capacitor 67 would be about four times as great as the resistance components of the circuit and the current flowing would be proportionately reduced. Resistor 68 having about the same impedance as capacitor 67 at 600 cycles, is shunted around capacitor 67 and the sensitivity is maintained relatively constant at the reduced level for the low voice frequencies. Since pad 66 is chosen to have a constant input impedance, changes of adjustment will not change the pre-emphasis characteristic of the microphone circuit network. Thus voice frequency voltages created in the microphone network are applied to the control grid of the reactance tube V1 at a preselected amplitude such that an operator speaking very loud into the microphone will not over swing the oscillations of the oscillating circuit for tube V2.

The modulation indicating feature includes tubes V6 and V7 and an indication lamp 77 located in the control unit CU. The tube V6 receives power from the microphone circuit network, a connection extending from the high voltage side of the secondary winding 15 through wire 71 and grid leak unit 72 to control grid 73 of tube V6, cathode 74 of tube V6 being connected to ground electrode 20. The plate 75 of tube V6 receives power from terminal B400 through front contact 24 of directional relay 25, wire 26, resistors 27 and 28, wire 78 and resistor 79.

The plate circuit of tube V6 is resistance coupled to the control grid 80 of tube V7 through capacitor 81 and the plate 82 of tube V7 receives power from the power source through a branch connection from wire 78, resistor 83 being interposed in the connection. Lamp 77 is preferably a glow discharge tube, such as a neon tube, and it has one terminal grounded and its other terminal connected to the plate 82 of tube V7 through wire 13 and a blocking capacitor 84. It follows that voice frequency voltages appearing in the input circuit of the reactance tube V1 are also applied to tubes V6 and V7 and a corresponding amplified voltage is applied to the lamp 77. The parts are proportioned so that a voice voltage of a predetermined magnitude sufficient to satisfactorily modulate the carrier generated by the oscillator tube V2 causes the lamp 77 to flash. Voltages below such predetermined magnitude will leave the lamp 77 dark. Thus, the speaker by observing lamp 77 can tell when he is speaking at the correct loudness. It is to be pointed out that the microphone circuit network is adjusted at pad 66 so that the background noise of usual magnitude will not create voltages sufficient to properly modulate the carrier frequency, but that voice frequencies above the energy level of the background noise causes proper operation of the transmitting apparatus and such magnitude of voice frequencies is required to flash the lamp 77.

A calling voltage is applied to the input of the reactance tube V1 for modulating the carrier, by the calling means, the calling voltage being of a frequency preselected to be of a different tone for each channel. The tube V6 normally used to

amplify the indication energy is switched to serve as an oscillator for the calling means. When calling relay 19 is energized in a manner to later appear, the circuit for primary winding 14 of transformer T1 is opened at back contact 70 so that the secondary winding 15 of the transformer may have maximum inductance and minimum power factor. An oscillating circuit network is formed by the top terminal of winding 15 being connected through wire 71 and grid leak unit 72 to the control grid 73 of tube V6, cathode 74 being connected to an intermediate terminal of winding 15 through front contact 88 of relay 19, plate 75 of tube V6 being connected to another intermediate terminal of winding 15 through blocking capacitor 87 and front contact 106 of relay 19, and a capacitor 86 being connected between the grid and plate leads through front contact 85 of relay 19 to form an oscillator tank circuit. Also, an additional capacitor 90 is connected in multiple with capacitor 86 through back contact 91 of the frequency change-over relay 50. That is, capacitors 86 and 90 are connected in multiple in the tank circuit when the channel selector relay 50 is released and capacitor 90 is removed from the tank circuit when the relay 50 is picked up. It is to be seen from this description that when calling relay 19 is picked up and the frequency change-over or channel selector relay 50 is released, the tube V6 functions as an oscillator to apply oscillations of a preselected tone frequency to the reactance tube V1 and the carrier is frequency modulated according to this tone frequency to provide a calling current which is supplied to the trackway transmitting circuit through the sending loop circuit. When relay 19 is picked up and the relay 50 picked up, the tube V6 is caused to serve as an oscillator to supply a tone frequency for modulating the second channel frequency f2, the second tone frequency being different from that supplied for the first channel. It is to be noted that during such calling conditions, the voltage appearing at the plate of tube V7 would be sufficiently high to excite the indication lamp 77, causing a constant illumination thereof. However, under such conditions, illumination of the lamp is not detrimental.

The emergency calling means for alternating switching tube V6 to serve as an oscillator to provide the calling tone for the first channel f1 and then to provide the calling tone for the second channel f2 and to alternately repeat such operation will be more fully explained when the operation of the apparatus is described.

The receiving apparatus comprises two complete receivers designated receiver F1 and receiver F2, respectively, receiver F1 being used for reception of current of the channel frequency f1 and receiver F2 being used to receive current of the second channel frequency f2. These receivers are alike except for the tuning and each may be of any one of several well-known arrangements. Each of the receivers preferably includes as essential elements a high frequency amplifier, a converter, an intermediate frequency amplifier, a limiter, and a discriminator. Each of these essential elements of the receiver is shown in block form for the sake of simplicity because the specific structure of each of these elements forms no part of my invention and they may be of any one of several well-known arrangements.

Two pick-up coils 92 and 93 are mounted on the caboose for inductive relation with the trackway transmitting circuit to pick up frequency modulated carrier current applied to such track-

way circuit at a remote station. These two pick-up coils 92 and 93 are connected to the input side of the high frequency amplifiers of the receivers F1 and F2, respectively.

The output of each discriminator of the two receivers is connected to a control grid of one section of a duo-triode tube V8, as will be readily understood by an inspection of Fig. 2. The plate circuits of the two sections of tube V8 are powered from the terminal B400 of the current source through proper resistors as will be also readily understood by an inspection of the drawing. The two plate circuits are coupled in multiple through capacitors 98 and 101 to a control grid 94 of a loud speaker amplifier tube V9, such connections of the plate circuits being described more fully shortly. Cathode 95 of tube V9 is connected to ground through a biasing unit 96, and the plate circuit of tube V9 includes a winding of a transformer T4 to a secondary winding of which transformer a loud-speaker LS is connected.

When the hand set HS of the control unit CU is placed on the hook switch S1 to close contact 97 and a triple-pole double-throw switch S2 is thrown to the left, that is, to the position illustrated in the drawing, the coupling connection from the plate circuit of the right-hand section of tube V8 as viewed in the drawing is completed through capacitor 98, contact blade 99 of switch S2, contact 97 of switch S1, a preselected portion of a volume control resistor 100, and control grid 94 of tube V9. Also, the coupling connection for left-hand section of tube V8 can be traced through capacitor 101, contact blade 102 of switch S2 and volume control resistor 100 to control grid 94 of tube V9. When the switch S2 is thrown to the right the connection of the left-hand section of tube V8 to tube V9 is then through contact blade 99 of switch S2 and the contact 97 of the hook switch S1, and the connection of the right-hand section of tube V8 to tube V9 is through the contact blade 102 of switch S2. Consequently when calling current is picked up by either pick-up coil 92 or 93, such calling current is amplified and demodulated and the respective tone frequency current is applied to the loud-speaker, the tone sounded by the loud-speaker depending upon the channel frequency. When the switch S2 is thrown to the left and the hand set HS is removed from the hook switch the left-hand section of tube V8 remains connected to the tube V9 to sound a calling current sent on the channel frequency f2 but the output of the receiver F1 is disconnected from the tube V9 and is connected to the earphone 107 of the hand set, this connection being completed through the contact 103 of the hook switch and a volume control resistance 103. Similarly, when the switch S2 is thrown to the right and the hand set is removed from the hook switch the receiver F1 remains connected to the loud speaker to sound a calling current sent over the frequency channel f1 but the output of receiver F2 is disconnected from the loud-speaker and the earphone of the hand set is connected to the output of this receiver F2, the connection now including the contact 103 of the hook switch and the volume control resistor 108. The volume control resistor 100 is preferably provided with stop 109 so that the sensitivity of the loud-speaker cannot be reduced below a desired limit.

The switch S2 also serves to determine the frequency channel of the transmitting apparatus. When switch S2 is thrown to the left a circuit is prepared for terminal N32 through contact blade

111, wire 117, front contact 118 and transfer contact 115 of a continuity transfer type of contact of relay 76, wire 116 and winding of frequency change-over relay 50 to ground, and relay 50 is normally deenergized to condition the transmitting for channel f1. The relay 50 can be picked up and the transmitter conditioned for channel f2 by the energizing of relay 76 when switch S2 is thrown to the left. With switch S2 thrown to the right a circuit is formed from terminal N32 through blade 111, wire 113, back contact 114 and transfer contact 115 of relay 76, wire 116 and winding of relay 50 to ground, and relay 50 is normally picked up to condition the transmitter apparatus for channel f2, but relay 50 can be released and the transmitter conditioned for channel f1 by the picking up of relay 76.

Also, when the frequency control switch S2 is thrown to the left to establish channel f1, current flows from terminal N32 through blade 111 and lamp 110 to ground and lamp 110 is illuminated to indicate the use of channel f1. Similarly, with switch S2 thrown to the right, current flows through lamp 112 and that lamp is illuminated to indicate the use of channel f2.

It follows that switch S2 serves as a frequency channel control device, the left and right-hand positions of switch S2 selecting channels f1 and f2, respectively. Such selection can be reversed, however, by relay 76.

I will next point out the circuits which reduce the sensitivity of the receiver of the channel in use during the time of transmission at the same station. Assuming that communication is being carried on through channel f1, a shunt circuit is formed across the output side of the high frequency amplifier of receiver F1, such shunt circuit being traced from one output terminal of the high frequency amplifier through resistor 119, wire 120, back contact 121 of relay 50 and front contact 122 of relay 25 to ground, the other output terminal of the high frequency amplifier being also grounded. The resistor 119 is proportioned so that during the sending period of the transmitter TA, the energy picked up by the coil 92 and applied to the receiver F1 is shunted sufficiently for the energy heard in the earphones to be at about the same level as that during the transmission from a remote station. In a similar manner if communication is being carried on through channel f2, a shunt circuit is completed across the output side of the high frequency amplifier of the receiver F2 during the sending period of the transmitter, this shunt circuit extending from one output terminal of the associated high frequency amplifier through resistor 123, wire 124, front contact 125 of relay 50, front contact 122 of relay 25 and to ground, the other output terminal of the respective high frequency amplifier being grounded. It is clear, therefore, that these shunt circuits cause a reduction in the sensitivity of the receiver during transmission and each receiver will provide a satisfactory tell-tale sound in the earphones of the hand set, such sound serving to indicate the operativeness of the transmitting apparatus and of the receiving apparatus then in use.

Referring to Fig. 3, there is disclosed means for coupling the transmitting apparatus TA and the receiving apparatus RA of a wayside station WS to the transmitting channel. The transmitting apparatus TA and the receiving apparatus RA are shown in Fig. 3 in block form, each of these apparatuses being similar to the corresponding apparatus of Figs. 1 and 2. A line wire L1 extends

11

along the railway in either or both directions from station WS and this line wire may be an existing wire included in some present circuit or it may be a wire placed on a pole line to serve as a part of the transmitting circuit.

Secondary winding 46 of output transformer T3 of apparatus TA is connected between line wire L1 and ground through contacts of the frequency change-over relay 50. Substantially the full winding is included in this connection when relay 50 is picked up to close front contact 62 and a preselected portion of winding 46 is included in the connection when relay 50 is released closing back contact 49. Thus a larger voltage is applied to the transmitting circuit at the lower channel frequency f2.

Since noise level is higher and Government regulations permit a given strength of energy at a greater distance from the line wire carrying the current for the lower frequency, more turns of the output winding can be used at the lower frequency. It is not necessary ordinarily to tune this output circuit at a wayside station since the line wire presents an impedance with a relatively large resistive component. Tuning can, of course, be used if desired.

The receivers F1 and F2 are coupled to the transmitting circuit through pick-up coils 92 and 93 which are disposed in inductive relation to line wires L1.

Fig. 4 discloses a second form of coupling the apparatus of wayside station WS to the trackway transmitting circuit. Line wires L2 and L3 extend along the railway in either or both directions from station WS and serve as elements of the transmitting circuit in the usual manner. These line wires L2 and L3 may be used in some other existing circuit. Two capacitors 145 and 146 are connected in series across wires L2 and L3, the full winding 46 of output transformer T3 is connected between the junction terminal of capacitors 145 and 146 and ground through front contact 62 of frequency change-over relay 50, and a preselected portion of winding 46 is included in this connection through back contact 49 of relay 50. Thus the voltage applied to the transmitting apparatus TA of the transmitting circuit is of a value preselected according to the channel frequency used.

In Fig. 4 the input terminals of receivers F1 and F2 are connected between the junction terminal of capacitors 145 and 146 and ground. It is clear that in Fig. 4 the wayside apparatuses are capacity coupled to the transmitting circuit. It is apparent that inductive coupling can be used in Fig. 4 either by inductive coils wound in inductive relation to wires L2 and L3 or another wire extending some distance parallel to wires L2 and L3.

In describing the operation of the apparatus, I shall first consider Figs. 1 and 2 and shall assume that the apparatus occupies its normal position, that is, the position illustrated in the drawings. At the start it is to be observed that the filaments of the various tubes are all heated through suitable filament circuits not shown. Under this normal condition calling current may be picked up by coil 92 due to some remote station sending out a calling current of the channel frequency f1. The energy thus picked up is supplied to the receiver F1 and after amplification and demodulation, the tone frequency current is applied to tube V8 and thence to tube V9 and to the loud-speaker which sounds the calling tone to inform the operator that communication is

12

desired on the channel frequency f1. Similarly, if energy is picked up by the coil 93 due to a remote station sending a calling current of the channel frequency f2 the picked up energy is applied to the receiver F2 and after amplification and demodulation the tone current is applied through tubes V8 and V9 to the loud-speaker and the operator is informed that communication is desired on channel f2, the operator distinguishing between the channels by the different tones of the calling currents.

Assuming first that the calling tone is for channel f1, the operator would set switch S2 to the left if it is not already in that position and would remove the hand set HS from the hook to connect the hand set to the output of the receiver F1 leaving the receiver F2 connected to the loud-speaker. The operator after removing the hand set from the hook switch presses the press-to-talk switch 5 on the hand set and speaks an agreed salutation into the microphone 63. The closing of the press-to-talk switch 5 completes the connection for current to flow from battery terminal B32 to ground electrode 64 switch 5, wire 126 and winding of directional relay 25 to battery terminal N32, and the directional relay 25 is picked up. The picking up of relay 25 to close front contact 24 applies plate voltage to the tubes of the transmitting apparatus, and the closing of front contact 122 of relay 25 applies the shunt circuit across the receiver F1, so that the transmitting apparatus is excited and the receiver F1 is reduced in sensitivity. With the tubes of the transmitter energized voice frequencies created by speaking into the microphone 63 are applied to tube V1 with the result a frequency modulated carrier telephone current is applied to the loop circuit and thence to the trackway transmitting circuit for transmission to remote stations. Such energy is also picked up by pick-up coil 92 and applied to respective receiver F1 and the voice frequencies are reproduced at a reduced energy level in the respective earphone 107 of the associated hand set to check the operation of the apparatus. From this point on two way conversation can be carried on between the operator of the caboose and the remote station by the operator properly operating the press-to-talk switch 5.

It is clear that during such a conversation through the communication channel f1, calling current can be received on the channel f2 and such calling tone sounded by the loud-speaker, such calling serving as a break in.

Assuming next that the calling current picked up is that for the channel f2, the operator to answer such call would first throw the switch S2 to the right and then remove the hand set HS from the hook. The throwing of the switch S2 completes the circuit for the frequency change-over relay 50 and that relay picks up and conditions the transmitting apparatus for operation on the channel frequency f2. The removal of the hand set from the hook connects it to the output of the receiver F2 leaving the receiver F1 connected to the loud-speaker for sounding any call that may be thereafter received on that channel. From this point on the caboose operator can answer the call and carry on a conversation with a remote station through the channel f2 in substantially the same manner as explained in connection with the communication on the channel f1.

In connection with communication on either channel, the speaking at proper loudness by the

operator will be indicated by the flashing of lamp 77 in the manner explained hereinbefore.

If a conversation is being carried on through one channel and a call is received through the other channel, such call can be immediately answered by the reversing of the switch S2. Also, the channel in use will be indicated through the lamps 110 and 112 of the control unit.

In the event the operator on the caboose desires to initiate communication, he first sends a calling current corresponding to the channel through which he wishes to communicate, selection of the channel being effected by the proper position of the switch S2. The operator would then depress a push button K1 of the control unit to close contacts 127 and 128. The closing of contact 127 of push button K1 completes the circuit for energizing relay 25 and that relay on picking up applies power to the tubes of the transmitting apparatus. The closing of contact 128 of the push button K1 completes a circuit for current to flow from battery terminal B32 through ground electrode 129, winding of relay 19, wire 130 and contact 128 to battery terminal N32, and relay 19 is energized. The picking up of relay 19 switches tube V6 to serve as an oscillator and oscillations of the calling frequency for the channel selected are applied to the reactance tube V1 to modulate the carrier and a corresponding calling current is applied to the track-way circuit through the caboose loop circuit. Subsequent to the proper answer back of such a calling current the operator would remove the hand set of the hook switch and carry on a conversation in the manner previously explained.

In the event the caboose operator wishes to send an emergency calling current, that is, a calling current alternately on each of the two channel frequencies, the operator depresses a push button K2 of the control unit closing contacts 131, 132 and 133. The closing of contact 131 completes the circuit for relay 19 and relay 19 on picking up switches the tube V6 to serve as an oscillator. The closing of contact 133 of the push button K2 completes the circuit for relay 25 and that relay on picking up applies power to the transmitting tubes. The closing of contact 132 of the push button K2 completes a circuit for relay 76, the circuit for relay 76 extending from positive terminal B32 through ground electrode 134, back contact 135 of relay 76, winding of that relay, wire 136 and contact 132 to terminal N32. A capacitor 137 is connected across the winding of relay 76 to cause this relay to be slow acting. Since relay 76 is controlled through its own back contact 135, this relay will alternately be energized and deenergized. The circuit for change-over relay 50 is controlled through the contacts 114, 115 and 118 of the relay 76 and thus with relay 76 alternately energized and deenergized, the relay 50 in turn is alternately picked up and released, and relay 50 when released conditions the transmitting apparatus to operate on channel frequency f1 and when picked up conditions the transmitting apparatus to operate on the channel f2. It follows, therefore, that as long as the push button K2 is held depressed, the relay 76 causes the transmitting apparatus to be alternately conditioned for sending a calling current first on the frequency channel f1 and then on the frequency channel f2. Such emergency calling condition would be useful when it is desired to call all trains with some of the trains carrying on a communication through channel f1 and other trains carrying on a communication through channel f2.

Communication between an operator at the wayside station of either Fig. 3 or Fig. 4 and a train would be carried on in substantially the same manner as just explained in connection with the station in caboose CO.

Apparatus such as here disclosed has the advantages that trains can carry on a conversation on the different channels without interference between different trains. A call can be received on a train on any one of the channels and a call can be received on a train on the channel not in use to serve as a break in. Also, any station can call all the trains irrespective of what channel they may be at the time carrying on communication through the emergency calling condition which alternately sends pulses of calling current on the two channel frequencies. Furthermore, the usual background noise created at locations on a train is suppressed and pre-emphasis is provided by adjustment of the microphone circuit. Proper speaking during a conversation is indicated to the operator. Checking of the integrity of the transmitting apparatus and of the receiving apparatus is provided and the use of frequency modulation assures that noise created by static conditions is avoided.

Although I have herein shown and described but one form of railway train communication systems embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In a railway train communication system for communication between the trains of a division of the railway through a common transmitting medium and by use of currents of different carrier frequencies, a plurality of stations at least one for each train, each said station provided with communication equipment and which equipments are substantially alike for all stations; each said equipment including transmitting apparatus, receiving apparatus, a frequency selector means and a telephone set; said transmitting apparatus having elements electrically coupled to said transmitting medium and including means capable of being differently conditioned to supply carrier telephone current of different carrier frequencies, said receiving apparatus including an individual receiver for each of said different carrier frequencies, each said receiver including an element electrically coupled to said transmitting medium and each having means operable to demodulate carrier telephone current of the respective carrier frequency, each said receiver normally active for each station to be ready to receive on any one of said carrier frequencies, and said selector means including circuit controllers operable to different positions and circuits connected to the transmitting and receiving apparatuses to preselect the condition of the transmitting apparatus and to effectively connect said telephone set to the receiver for the carrier frequency corresponding to the selected condition of the transmitting apparatus, whereby each station is enabled to communicate with any one of the other stations on any one of said plurality of carrier frequencies and a plurality of noninterfering two-way communication can be carried on simultaneously between a plurality of different pairs of said stations.

2. In a railway train communication system for communication between the trains of a division of the railway through a common transmitting

15

medium and by use of calling and telephone currents of a plurality of different carrier frequencies, a plurality of stations at least one for each train; each said station provided with communication equipment and all of which equipments are substantially identical; each said equipment including transmitting apparatus, receiving apparatus, control means, a loud-speaker and a telephone hand set; said transmitting apparatus having elements electrically coupled to said transmitting medium and including means capable of being differently conditioned to supply a carrier telephone current of a first or a second carrier frequency or a calling current of either said carrier frequencies modulated by an individual tone frequency; said receiving apparatus including an independent receiver for each of said carrier frequencies; each said receiver including a pick-up element electrically coupled to said transmitting medium and each having means which is normally active for demodulating the telephone and calling currents of the respective carrier frequency; and said control means including contacts operable to different circuit arrangements to normally connect said receivers in multiple to said loud-speaker at a given normal arrangement of its contacts and to selectively condition the transmitting apparatus to supply calling and telephone currents of a preselected one of the carrier frequencies and connect the telephone set to the receiver of such selected carrier frequency and the loud-speaker to the receiver of the non-selected carrier at different given operating arrangements of its contacts, whereby each station can be called by any one of the other stations through its loud-speaker on either of said carriers and communicate by telephone through its telephone set with the calling station and at the same time be in condition to receive a call or message through its loud-speaker from any one of the other stations.

3. In a railway train communication system for communication between the trains of a division of the railway through a common transmitting medium, a plurality of stations at least one for each train; a plurality of substantially like communication equipments one at each of said stations and each of which equipments includes a multiple frequency channel transmitting apparatus; a multiple frequency channel receiving apparatus; a telephone set and a channel selector means; said transmitting apparatus having elements electrically coupled to said transmitting medium and including devices which are capable of being differently conditioned to supply carrier telephone current of any one of the channel frequencies; said transmitting apparatus at each station being normally inactive, said receiving apparatus including an independent receiver for each of said channel frequencies, each said receiver having an element electrically coupled to said transmitting medium and including devices which are operable to detect the telephone current of the respective channel frequency, each said receiver at each station being normally active, said selector means including controllers operable to different positions and a circuit network having connections to the transmitting and receiving apparatuses to preselect the condition of said transmitting apparatus and to effectively connect said telephone set to the transmitting apparatus and to the receiver of the channel frequency corresponding to the selected condition of the transmitting apparatus, and a push-to-talk means at each said station operable to selectively

16

activate the transmitting apparatus and the receiver with which the telephone set is connected, whereby a plurality of two-way telephone communications can be carried on simultaneously between different pairs of said trains without interference between the different conversations.

4. In a railway train communication system the combination comprising, an electron tube oscillator including an oscillating circuit and an electron tube provided with input and output electrodes, said tube electrodes connected to the oscillating circuit in such a manner as to generate a carrier frequency current, a reactance electron tube provided with output electrodes and a control electrode, said output electrodes connected to the oscillating circuit of said oscillator to frequency modulate the carrier according to voice frequencies applied to the control electrode of said reactance tube; a circuit network including a microphone, a resistance pad and a transformer and connected to said control electrode of the reactance tube to apply voice frequencies to said control electrode; said circuit network proportioned to suppress background noise below a given level, and indication means including a voice frequency energy responsive device and connected to said circuit network to indicate when the energy applied to said control electrode is above said given level to indicate correct loudness of speaking into said microphone for satisfactory transmission of the corresponding frequency modulated carrier telephone current.

5. In combination, railway train communication receiving apparatus for reception of the telephone and calling currents of a plurality of different carrier frequency channels, said receiving apparatus comprising an independent receiver for each of said channels, a loud-speaker, an earphone, each said receiver having input and output circuits and including a demodulating device capable of demodulating the telephone and the calling currents of the respective carrier frequency channel, and manually operable switching means having a first position to connect the output circuits of said receivers in multiple to said loud-speaker to sound the calling tone of the calling current or the speech of the telephone current of any of said channels, and said switching means having other positions to connect the output circuit of any selected one of said receivers to said earphone with the output circuits of the remaining receivers connected to the loud-speaker only to permit telephone communication through the channel of the selected receiver, the calling tone and speech of any of the other channels being sounded at the loud-speaker.

6. In railway train communication apparatus for reception of a plurality of different carrier telephone currents, the combination comprising, a plurality of different receivers one for each of said different telephone currents, each said receiver having input and output circuits and including means capable of demodulating the respective carrier telephone current, pick-up elements one connected to the input circuit of each of said receivers, a loud-speaker, a telephone hand set having a hook switch, and manually operable switching means to cooperate with said hook switch to normally connect in multiple the output circuits of said receivers to said loud-speaker and to selectively connect the earphone of the hand set to the output circuit of any one of said receivers and the output circuits of the remaining receivers in multiple to the loud-speaker.

7. In combination, transmitting apparatus in-

17

cluding a modulator-oscillator, a microphone and a calling tone generator and which modulator-oscillator and tone generator are capable of being differently conditioned to supply carrier telephone current of any one of a plurality of different carrier frequencies and a calling current for each of said carrier frequencies, each said calling current being the carrier modulated with a predetermined tone frequency, a first manually controlled means having circuits connected to the transmitting apparatus to govern the conditions of the transmitting apparatus to preselect the carrier telephone current to be supplied, a second manually controlled means having circuits connected to the transmitting apparatus to govern the conditions of the transmitting apparatus to preselect the calling current to be supplied, and a third manually controlled means having circuits connected to the transmitting apparatus to govern the conditions of the transmitting apparatus to cause the calling currents to be supplied in a cyclic manner.

8. In combination, transmitting apparatus including a modulator-oscillator a microphone and a calling tone generator and which devices are capable of being differently conditioned to supply carrier telephone current of either a first or a second carrier frequency and a calling current of either of said carrier frequencies, each said calling current being the carrier modulated by a predetermined tone frequency, a first control relay operable to a first and a second position to govern the conditions of the transmitting apparatus to preselect the carrier frequency to be supplied, a second control relay operable to a first and a second position to govern the conditions of the transmitting apparatus to preselect the supplying of telephone current or of calling current, and a third control relay capable of code operation to govern the conditions of the transmitting apparatus to supply the calling currents alternately.

9. In combination, an electron oscillator tube having input electrodes and output electrodes which are connected to an oscillating circuit to generate a carrier frequency current, an electron reactance tube having a control electrode and output electrodes and which output electrodes are connected to said oscillating circuit to frequency modulate the carrier according to the voltages applied to the control electrode of the reactance tube; a circuit network including a microphone, a resistance pad, and a transformer connected to said control electrode to apply voice frequency voltages for frequency modulating said carrier; said circuit network proportioned for only voice currents above a predetermined energy level to be effective for modulating the carrier to suppress background noise, and indication means including an amplifier and an indicator connected to said circuit network to indicate voice currents above said predetermined energy level.

10. In combination, an electron tube oscillator having input and output electrodes which are connected to an associated oscillating circuit to generate oscillations of a predetermined carrier frequency, an electron reactance tube having a control electrode and output electrodes and which output electrodes are connected to said oscillating circuit to frequency modulate the oscillations according to voltages applied to the control electrode of said reactance tube; a circuit network including a microphone and an impedance unit connected to said control electrode to apply voice frequency voltages for supplying in the output of said oscillator a frequency modulated carrier tele-

18

phone current, and indication means including an amplifier electron tube and an indicator lamp connected to said circuit network to illuminate said lamp only when the voice current of the network is above a predetermined energy level.

11. In combination, an electron tube oscillator having an electron tube which is provided with input and output electrodes that are connected to an associated oscillating circuit to generate oscillations of a predetermined carrier frequency, an electron reactance tube having a control grid and output electrodes and which output electrodes are connected to said oscillating circuit to frequency vary the oscillations according to voltages applied to the control grid of the reactance tube; a circuit network including a microphone, a resistance pad, an impedance unit and a transformer connected to said control grid to apply at times voice frequency voltages to said control grid for supplying in an output circuit of said oscillator tube a corresponding frequency modulated carrier telephone current, and said resistance pad and impedance unit proportioned to pre-emphasize the higher voice frequencies.

12. In combination, transmitting apparatus including an electron tube oscillator having an electron tube provided with input and output electrodes and an oscillating circuit, said oscillating circuit connected to said tube electrodes in such a manner as to generate carrier frequency current, said oscillator capable of being differently conditioned to supply carrier current of either a first or a second frequency, control means having connection to said transmitting apparatus to govern said conditions, an electron modulator tube having a control electrode and output electrodes, said output electrodes being coupled to said oscillator to frequency modulate said carrier frequencies according to the voltage applied to the control electrode of said modulator tube, a circuit network including a microphone connected to said control electrode to apply voice frequency voltages thereto to frequency modulate whichever carrier is being supplied, and a potential divider including resistance interposed in said circuit network and governed by said control means to control said voice frequency voltages to effect substantially the same absolute frequency swing in the modulations of said carrier frequencies.

13. In a railway train communication system for communication between a wayside station and trains operating over a given territory of said railway through a transmitting circuit which includes a line wire extending along the trackway, the combination comprising, a wayside transmitting apparatus including means capable of being differently conditioned to supply carrier telephone current of a first or a second carrier frequency, said transmitting apparatus coupled to said transmitting circuit by being connected to said line wire and ground, and control means interposed in said connection to apply to the transmitting circuit a voltage predetermined for each said carrier frequency and which voltage is larger for the lower of the two carrier frequencies.

14. In a railway train communication system for communication between a wayside station and trains operating over a given territory of said railway through a transmitting circuit which includes the line wires extending along the railway, the combination comprising, transmitting apparatus and receiving apparatus at said wayside station, said transmitting apparatus including means capable of being differently conditioned to supply carrier telephone current of a

first or a second carrier frequency, said receiving apparatus including means operable to demodulate such carrier telephone currents, two capacitors connected in series across a pair of said line wires, a first connection to connect input terminals of said receiving apparatus between a junction terminal of said capacitors and ground, a second connection to connect output terminals of said transmitting apparatus between said junction terminal and ground, and said second connection including control means to apply to the transmitting circuit a voltage predetermined for each condition of the transmitting apparatus and which voltage is larger for the lower of the two carrier frequencies.

15. In a railway train communication system which provides equipment on all or nearly all of the trains of a division for telephone communication on either a first or a second frequency channel and for each of which channels a carrier telephone current and a calling current are provided, each said equipment including transmitting apparatus and receiving apparatus, each said transmitting apparatus having means capable of being conditioned to supply the calling current for each said frequency channel with each said calling current having an individual characteristic, each said receiving apparatus including two independent receivers one for each said frequency channel, each said receiver having means for detecting the calling current and the carrier telephone current of the same channel, the receivers of each of said trains normally active to detect the calling current of the respective frequency channel and each receiver capable of being conditioned to receive the telephone current of the respective frequency channel, control means for each such train, and each control means having circuits connected to the transmitting apparatus and including a controller operable to at times condition the transmitting apparatus of the same train to supply the calling currents of said first and second frequency channels alternately to call all trains when some of the trains are telephoning on one frequency channel and others on the other frequency channel.

16. In combination, transmitting apparatus including means capable of being conditioned to supply telephone current of any one of a plurality of different frequency channels and a calling current for each said channel and also an emergency calling circuit, each said calling current having an individual characteristic, a first control means including a controller and circuits connected to the transmitting apparatus and operable to different positions to control said transmitting apparatus to preselect the frequency channel, a second control means including a controller and circuits connected to the transmitting apparatus and operable to different positions to control said transmitting apparatus to supply the calling current for the channel preselected by said first control means, and a third control means including a controller and circuits connected to the transmitting apparatus and operable to control the transmitting apparatus to supply an emergency calling current of a distinctive characteristic irrespective of the position of said first control means.

17. In a railway train telephone system for two-way communication between different train carried stations each of which stations is equipped with a telephone transmitter and a receiver using a carrier frequency telephone current, the combination comprising, push-to-talk

means at each station to normally condition the receiver of the station for reception and to deenergize the transmitter, generating means at a station capable of supplying oscillations of a preselected tone frequency but normally inactive, circuit connections to connect said generating means to the transmitter of the same station to modulate the carrier by said oscillations, a circuit interrupter device normally deenergized, means including contacts of said interrupter device connected with said generating means to cause the generating means to recurrently supply said oscillations to create a distinctive signaling current of the modulated carrier, and control means having circuits and a circuit controlling switch operable to at times energize said transmitter, to render said generating means active and to energize said circuit interrupter device to sound at the receiver of each of the associated stations a distinctive signal.

18. In a railway train communication system for telephone communication between the trains and selected wayside offices of a railway by use of a common transmitting medium and by the use of calling and telephone currents of a plurality of different carrier frequency channels, a communication station on each of the trains and at each of the offices, each said station provided with communication equipment all of which are substantially alike to enable any one of the stations to communicate with any other one of the stations; each said equipment including transmitting apparatus, receiving apparatus, selector means, a control circuit means, a loud-speaker and a telephone set; each said transmitting apparatus including a transmitter having means capable of being differently conditioned for supplying calling and telephone currents of any one of the plurality of different carrier frequencies, each said transmitter having an element coupled to the transmitting medium but normally inactive, each said receiving apparatus including an individual receiver for each of the different carrier frequencies, each said receiver having means operable to demodulate the calling and telephone currents of the respective carrier frequency, each said receiver having an element coupled to the transmitting medium and normally active, the receivers of each station having their outputs connected in multiple to the loudspeaker of the same station to enable each station to receive a call from any one of the other stations on any one of the carrier frequencies, each said selector means including a controller operable to different positions and circuits connected to said transmitter and receivers to select by its position and condition of the transmitter of the same station and to connect the telephone set to the receiver of the station for the carrier frequency corresponding to the carrier frequency of the selected condition of the respective transmitter, the loudspeaker being disconnected from the selected receiver but retained connected to the remaining receivers, and each control circuit means including a push-to-talk device to selectively activate the transmitter and the receiver to which the telephone set is connected.

19. In a communication system for vehicles operating over a given stretch of their trackway and using telephone currents of a plurality of different carrier frequency channels to enable each vehicle to telephone to any other vehicle by use of a common transmitting medium, communication equipment on each said vehicle and all of which equipments are substantially alike; each

21

said equipment including transmitting apparatus, receiving apparatus, a telephone set and selector circuit means; each said transmitting apparatus including means capable of being differently conditioned to supply carrier telephone current of any one of the plurality of different carrier frequency channels, each said transmitting apparatus having elements disposed for communication relationship with the transmitting medium but normally inactive, each said receiving apparatus including an individual receiver for each of said different carrier frequency channels, each said receiver including means capable of demodulating carrier telephone current of the respective carrier channel and having elements disposed for communication relationship with the transmitting medium in a normally active condition, each said selector circuit means including circuits connected to said transmitter and receiving apparatuses and operable to different conditions to select by its condition the condition of the transmitting apparatus of the same vehicle and to

22

effectively couple the telephone set to the transmitting apparatus and to the receiver of the carrier channel corresponding to that selected for the transmitting apparatus.

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Certificate of Correction

Patent No. 2,484,680

October 11, 1949

PAUL N. BOSSART

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 19, line 52, for the word "circuit" read *current*;
and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 31st day of January, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.